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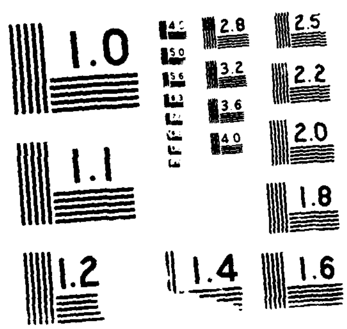
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AIR COMMAND AND STAFF COLLEGE

STUDENT REPORT

THE FEASIBILITY OF CONVERTING THE TANKER, TRANSPORT, AND BOMBER (TTB) TRACK OF SPECIALIZED UNDERGRADUATE NAVIGATOR TRAINING (SUNT) TO AN ALL-SIMULATOR COURSE

MAJOR STUART D. SAUERBRY 88-2325

"insights into tomorrow"

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REPORT NUMBER 88-2325

TITLE THE FEASIBILITY OF CONVERTING THE TANKER, TRANSPORT, AND BOMBER (TTB) TRACK OF SPECIALIZED UNDERGRADUATE NAVIGATOR TRAINING (SUNT) TO AN ALL-SIMULATOR COURSE

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Submitted to the faculty in partial fulfillment of requirements for graduation.

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Navigator training programs and syllabi have gone through numerous evolutions to provide students with the requisite knowledge, skills, and experience to enter combat crew training. Similarly, flight simulators have been the focus of many Air Force modernization programs designed to enhance simulator capabilities across a wide spectrum. State-of-the-art technology has brought about advanced flight simulators with sophisticated visual systems, highly realistic crew training and enhanced instructor roles. Cost considerations aside, questions still remain as to whether modern flight simulators are or will be feasibly capable of adapting students to the physical and psychological stresses of flight, or adequately preparing them to enter combat crew training. This research specifically examines the potential feasibility of an all-simulator program for the Tanker, Transport, and Bomber track of Specialized Undergraduate Navigator Training.

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PREFACE

Undergraduate Navigator Training has evolved through numerous program and syllabi changes in its quest to provide navigators with the requisite knowledge, skills, and experience to enter combat crew training. Aircraft and simulator modernization has been a part of that evolution with the introduction of the T-43 aircraft and the T45 simulator. Flight training simulators in particular have been the focus of many Air Force programs to enhance simulator capabilities across a wide spectrum. State-of-the-art technological sophistication has given simulators advanced capabilities for visual systems, realistic crew training, and enhancing the role of the instructor. Have simulators advanced to the point that they could feasibly replace initial flight training programs? Would the simulator trained graduate be prepared to enter combat crew training? Would he or she be able to adapt to the stresses of the airborne environment? This paper will attempt to answer those questions as they pertain to the Tanker, Transport, and Bomber track of the Specialized Undergraduate Navigator Training program.

The author would like to acknowledge the patient and persistent help of the Fairchild Library staff. Their assistance was invaluable in what proved to be an arduous task of locating source materials. Also, the guiding hand of the author's Faculty Advisor, Major Jimmy Connors, helped get this paper headed in the right direction and then kept it on track. Finally, a very special thank you to the author's wife for her patience, encouragement, and assistance with proofreading and editing.

ABOUT THE AUTHOR

Major Stuart D. Sauerbry is a 1974 graduate of the Air Force Reserve Officer Training Corps program and the University of Evansville at Evansville, Indiana. He entered Undergraduate Navigator Training (UNT) in September, 1974 and graduated in May, 1975. He was subsequently assigned as a C-130 navigator with the 773 Tactical Airlift Squadron stationed at Dyess Air Force Base, Texas. While there, he flew on four European rotations and was airland, airdrop, Grid, and Primary Nuclear Airlift qualified. Major Sauerbry attended Squadron Officer School in-residence in the Spring of 1978. In March of 1979, Major Sauerbry was reassigned to Mather Air Force Base, California, as a UNT instructor with the 452 Flying Training Squadron. He later served as Squadron Phase Manager where he was intimately involved in the development of the Navigation Procedures and Advanced Navigation curriculums. Before the end of his tour, he also served as a Wing Scheduler, Squadron Executive Officer, and Assistant Operations Officer. In July, 1984, Major Sauerbry was reassigned to Little Rock Air Force Base, Arkansas, as a C-130 formal school instructor. During his tour, he served in a variety of positions including, Flight Examiner, Flight Commander, Chief Scheduler, and Executive Officer. During that time, he acquired three years of operational experience teaching in the C-130 Weapon System Trainer and Satellite Navigation Station. Major Sauerbry is married to the former Marlene Marie Christen of Elkader, Iowa.

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I. *Purpose:* Determine whether simulator technology has advanced sufficiently so that students in the SUNT TTB track could feasibly be trained in an all-simulator course.

II. *Problem:* Although modern flight simulators are highly sophisticated and versatile training systems, they still lack the realism of flight training. Consideration of an all-simulator program for the SUNT TTB track must include a close examination of the role stress plays in learning aircrew skill, the necessity of students to acclimate to the airborne environment, and flight simulator capability to re-create the human experience with actual flight.

III. *Data:* The current navigator training program, SUNT, has evolved from a host of program modifications. These modifications resulted from changes in AF/MAJCOM training requirements, weapon systems/equipment, and training aircraft/simulator

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technology. The T-43 aircraft and the T45 simulator were both major strides in modernizing navigator training. Since their acquisition, attrition rates have stabilized near the programmed attrition rate. Historically, nearly half of all attritions have been for flying deficiencies. This fact tends to emphasize the importance of flight training in navigator training programs. Stress associated with flying is also of major importance to any flying training program. Stress in an integral and possibly beneficial part of flying training, but a student's ability to deal with the stress may well determine his or her suitability as a crewmember. Simulators as well have played major roles in the quality of training students receive. However, the Air Force has taken notice that state-of-the-art sophistication does not necessarily equate to training effectiveness. More emphasis is being placed on using simulators to enhance crewmember training rather than simply producing aircraft replicas. There is also a growing realization that flight simulators, for all their sophistication, do have their limitations. The MAJCOMs who train SUNT TTB graduates (MAC, TAC, SAC) as combat crewmembers express unanimous concern over simulator limitations and their ability to adequately acclimate student crewmembers into the flying environment. The MAJCOM experts viewed flight simulators as valuable and sophisticated training aids, but not as replacements for actual flight training. In their collective opinion, there is no suitable substitute method for determining a student crewmember's performance than in an actual aircraft.

IV. Conclusions: The entire purpose of SUNT is to train crewmembers who are prepared to enter combat crew training programs. Simulators play major roles in preparing navigators for flight training, and sophistication promises to enhance those roles. However, flight training, particularly initial flight training, has consistently been the bottom line determinant in whether student navigators can successfully adapt to the demands and stress of flying. As a result, the concept of converting the SUNT TTB program to an all-simulator course is simply not feasible.

GLOSSARY

TERMS AND DEFINITIONS

AIRBORNE ENVIRONMENT: The airborne environment encompasses the total spectrum of actual flight as it relates to the crewmember. It includes, but is not limited to, interaction with other crewmembers, physical and psychological stress, the potential of physical risk, the unpredictability of atmospheric conditions, cabin altitude variations, and aircraft accelerations in three dimensions.

AIRCREW TRAINING DEVICE (ATD): Simulators that are categorized as Part Task Trainers (PTT), Weapon System Trainers (WST), Operational Flight Trainers (OFT) and Cockpit Procedures Trainers (CPT). Categorization is based upon degree of sophistication and capabilities (Motion, Visual, Hardware and Software). Normally, ATDs are used to train aircrews as a crew, rather than an individual aircrew member. (25:48-49)

AIRCREW MEMBER: An officer who is enrolled in or has graduated from an undergraduate flying training course(s). An enlisted member who is upgrading to or is qualified in a specific aircrew position and is drawing flight pay.

FULL-TASK SIMULATOR: A simulator complex capable of providing full aircraft mission simulation from power-on through takeoff, enroute, landing and power-down. Crewmembers may be trained singularly, in multiples of the same crew position, or in concert with other crew positions.

ASSUMPTIONS AND LIMITATIONS

Specialized Undergraduate Navigator Training (SUNT) The SUNT program is a relatively new approach to training navigators. The first class entered training in mid-1986. (5:68) As a result, the bulk of historical and statistical data on navigator training will have to be drawn from previous programs.

Navigator Career Field The navigator career field is largely military unique. As a crew position, navigator primary duties are designed around making an aircraft into a viable weapon system in a hostile environment. As such, parallels are few to nonexistent in the commercial aviation industry. Further, the mass of studies of aircrew performance focus on pilot perfor

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mance, commercial or military. Due to the lack of navigator-specific performance studies, careful parallels will have to be drawn with military pilot performance where such performance equates or relates to navigator performance.

Cost Considerations Cost considerations in the study of training programs are both important and broad in scope. However, this study focuses on the concept validity of training navigators in an all-simulator environment. While cost and related issues are acknowledged important factors, they are distinct and separate issues which are outside the limited scope of this study. However, cost considerations are many times inseparably related to most simulator and training program issues. In such cases, cost issues may be mentioned as side issues to help explain or discuss the central issues involved.

Chapter One

INTRODUCTION

The airborne navigator profession has largely been unique to the military. The navigator's training ultimately prepares him or her to fly on missions into a hostile environment to conduct aggressive or covert military operations. Many navigator-specific duties are directly linked to the accomplishment of the combat mission of a particular sortie or aircraft. Such missions might include rescue, airdrop, bombing, electronic surveillance, command and control, refueling, or electronic warfare. (23:A8-35 - A8-45.5) How well the navigator performs will have a direct impact on mission success or failure. How well the navigator is trained will have a direct impact upon how well he or she performs on a particular mission.

Currently, all undergraduate navigator training for the Department of Defense (DOD) is conducted at Mather Air Force Base (AFB), California. Air Training Command (ATC) has recently brought on line the Specialized Undergraduate Navigator Training (SUNT) program as a new system of training United States Air Force (USAF) and international officers as navigators. The SUNT program concept is designed to provide Major Air Commands (MAJCOMs) with navigators who have "specialized" in navigation skills more germane to the type missions and aircraft they will be flying. After completing a common "Core" course, students enter one of three specialized "tracks" depending upon operationally assigned aircraft. Each track syllabus contains a varying mix of academics, simulators and flights, concentrating training on those navigational skills that will be needed and used operationally. As such, each student receives training more commensurate with the needs of his operationally assigned aircraft and MAJCOM. (22:11-13) Viewed in the long term, the SUNT program is an evolutionary step toward providing navigators better trained and prepared for their roles as aircrew members on combat missions.

The question that arises is what should be the next step in the evolution of navigator training? Should the Air Force study the use of state-of-the-art simulators to completely replace flight training as was suggested in a "Think Piece" at the Air Staff? (34:3) This study will examine the ramifications of that very issue as it pertains to the Tanker, Transport, and Bomber (TTB) track of SUNT. While there would be major impacts on the other two tracks as well, the ramifications would be so diverse and broad as to be beyond the scope of this study. Cost considerations are also a totally separate issue and beyond the scope of this study. Rather, the author will examine the feasibility of using simulators to completely replace flight training in the SUNT TTB track. Has simulator technology brought us to the next evolutionary step in navigator training, or would such a concept exceed the abilities and purpose of simulators? Ultimately, the bottom line issue to be answered is whether an all-simulator SUNT TTB program would provide navigators trained and prepared to enter combat crew training.

Chapter Two

MODERN NAVIGATOR TRAINING

In this chapter, the author will discuss the evolution of modern navigator training. The implementation of an up-to-date aircraft and simulator were key features in this modernization. Yet, it took a syllabus to provide direction and guidance for the training program. Syllabi, too, were updated as modern undergraduate navigator training programs matured and evolved. The growth and modernization of these systems and programs provide the background for the implementation of the current training program.

THE T-43 AIRCRAFT

Beginning in the mid-1960s, the Air Force began to look for a replacement for its primary navigator training aircraft: the T-29. The culmination of that research brought the gradual operational phase-in of the current navigator training aircraft: the T-43.

> The T-43, the military version of the Boeing 737 airliner, [is] the principal aircraft used . . . for undergraduate navigator training. The aircraft [is] specially equipped with tactical navigation [TACAN] and long range air navigation [LORAN] equipment, Doppler and search radar, the inertial navigation system [INS], VHF Omnirange [VOR], radar altimeter, and all required communications equipment to train student navigators for the operational environment of strategic, tactical, airlift, and tanker aircraft. Inside the aircraft [are] 12 student stations, three instructor stations, and four stations for proficiency training. Spaced along the topside of the aircraft [are] five periscopic sextant[s]--one for each student-instructor complex and proficiency station. The aircraft [is] powered by two Pratt and Whitney JT8D-9A jet engines, and [is] capable of attaining cruise speeds up to 535 miles-per-hour. With an operating range of approximately 2,730 nautical miles, the T-43 [can] fly at altitudes up to 35,000 feet. (20:47,48)

Thus, navigator training had entered the "jet age" with an up-to-date aircraft. More importantly though, the T-43 flew at altitudes and speeds comparable to those graduates would encounter in their operational aircraft and environments. Additionally, the on-board navigation equipment was more in line with the navigation equipment on operational aircraft. The T-43 was, and continues to be, a major step in the evolution of navigator training. However, their was another companion in this evolution: the T45 simulator.

THE T45 SIMULATOR

Although the T45 simulator's incorporation into the training program was initially delayed due to some technical and contractual "bugs," it was brought on line on 15 March 1976 (18:15; 19:9) and has been an integral part of the navigator training program ever since. At the time of the T45 simulator's introduction:

> The T45 Navigation Trainer was one of the most sophisticated training devices in the Air Force's inventory. At a cost of approximately $32.1 million--which included the facility and associated aerospace ground equipment--the T45 [is] capable of simulating flight anywhere in the northern hemisphere, speeds up to Mach 2, altitudes from sea level to 70,000 feet, winds as high as 150 knots from any direction, and a radar digital landmass simulation of the continental United States. Housed in a 30,000 square-foot building, the T45 trainer consist[s] of 13 complexes with four student stations and an instructor station in each complex, a mission control center, and 42 computers which [provide] the navigational simulation. Additionally, each student station contain[s] the same avionics equipment as the T-43 aircraft. Since the student stations [are] equipped with the same avionics equipment as the T-43 aircraft, each of the 52 student stations [is] capable of individual flight. This, in effect, [makes] each student his own navigator, completely responsible for the success or failure of his individual mission, regardless of what the remaining students [are] doing. (20:28-29)

The T45 gives the navigator training program a modern, full-task simulator which mirrors its counterpart aircraft, the T-43, at the navigator's station. With a large degree of realism, the T45 simulator allows students to practice on navigation and equipment procedures before being required to perform them airborne in the T-43. Yet, the T45 is more than just a simulation of the T-43.

As noted earlier, the T45 has capabilities beyond the aircraft capabilities of the T-43. For instance, the Mach 2 speed allows the T45 to emulate fighter aircraft. This characteristic is particularly useful in training students in a high speed, low level environment--one of the primary fighter navigation roles. In an even broader sense, the wide range of speeds and altitudes allows the T45 to simulate many aircraft in a wide variety of navigational roles, making the T45 a highly versatile and flexible simulator. The independent operation of each complex further enhances that flexibility. So while the T45 is "equipment-specific" to the T-43, T45 capabilities extend far beyond the capabilities of the T-43.

SYLLABUS COMPARISON: SIMULATOR AND FLYING HOURS

Even with the most modern equipment, it takes a program to put that equipment to use. The two major syllabi that governed the UNT program (until implementation of SUNT) were ATC syllabus N-V6A-D and N-V6A-F. The forerunners to these syllabi were short-lived and do not provide adequate data for study. The "D" syllabus called for 85 T45 simulator hours and 105 T-43 flying hours per student. (16:46,61) The "F" syllabus called for 64 T45 simulator hours and 68 T-43 flying hours. (17:2-3) The important difference between the two syllabi is that "F" syllabus students would graduate, receive their wings, and enter another course in either Advanced Navigation, Tactical Navigation or Electronic Warfare. (21:11-13) Advanced Navigation, a forerunner of the current TTB track, contained 26 T45 and 20 T-43 hours. On the other hand, the SUNT Core Course contains 32 T45 hours (12:2,46-48) and 27.5 T-43 hours. (12:2) To be added to these hours are the TTB track: 68 T45 hours and 88 T-43 hours. (15:1) For comparison:

	T45	T-43
"D" SYLLABUS	85.0	105.0
"F" SYLLABUS AND ADVANCED NAV	90.0	88.0
SUNT CORE & TTB COURSES	100.0	115.5

Exact comparisons of the flying/simulator hours are difficult due to variations in course content and structure between the syllabi. However, as the T-43 and T45 have matured in the navigator training program, both have played and continue to play major roles in successive "versions" of the program.

PRODUCTION AND ATTRITION RATES - 1977 TO 1986

The key to understanding the effectiveness of the T-43 and T45 in concert with the "D" and "F" syllabi is to examine the major causes of attrition. The following information was drawn from "Attrition by Source/by Cause" tables compiled by HQ ATC/DOXP:

TABLE 1

FLYING DEFICIENCY AND MOA ATTRITION

FY CLASS	NET ENTRY	TOTAL ATTRITED	%	FLY DEF	%	MOA	%
77	770	68	8.8	16	2.0	2	.2
78	611	85	13.9	29	4.7	2	.3
79(D)	435	42	9.7	14	3.2	0	.0
79(F)	361	60	16.6	18	5.0	1	.3
79(TOT)	796	102	12.8	32	4.0	1	.1
80	837	134	16.0	54	6.5	2	.2
81	894	125	14.0	66	7.4	2	.2
82	1150	102	8.9	40	3.5	5	.4
83	1376	260	18.9	135	9.8	7	.5
84	1175	197	16.8	111	9.4	5	.4
85	1109	183	16.5	109	9.8	9	.8
86	1006	199	19.8	118	11.7	9	.9

(25:--)

TABLE 2

SYLLABUS ATTRITION COMPARISONS AND AVERAGES

	TOTAL ENTRY	TOTAL ATTRITED	%	FLY DEF	%	MOA	%
"D" SYLLABUS	1816	195	10.7	59	3.2	4	.2
"F" SYLLABUS	7908	1260	15.9	651	8.2	40	.5
10 YR AVG	9724	1455	15.0	710	7.3	44	.5

(25:--)

NOTE: The net entries include all officers enrolled, including international officers. Other reasons for attritions not shown above include the following: Academic, Medical, Self-Initiated Elimination, Training: Fatal, and Other. (25:--)

Examination of Tables One and Two above reveals several striking deductions as regards to syllabus changes. First, the percentage change in total attritions between syllabi jumped nearly 50 percent with the "F" syllabus. Also, the Flying Deficiency attrition climbed from 3.2% to 8.2%--over half the total attritions of the "F" syllabus. There are numerous external factors which drive attrition rates, including grading standards, officer-student selection criteria, and program severity. While external factors such as these may have caused year-to-year fluctuations, the "F" syllabus attrition trends tended to stabilize around markedly higher rates than those of the "D" syllabus. If the Air Force had been unduly concerned about higher attrition rates or MAJCOMs about graduate quality, the "F" syllabus viability would not have lasted nearly eight years. Additionally, the importance of **flying proficiency** in navigator training had been clearly established and consistently sustained over that same time period.

The durability of the "F" syllabus also highlights the fact that ATC had successfully designed a viable training program encompassing its modern T-43 jet aircraft and the full-task T45 simulator. This "marriage" of technology and program had gradually evolved as ATC became more experienced with the capabilities and potential of the T45 and T-43 to train navigators. Using attrition as a ruler, the average "F" syllabus attrition rate of 15.9% shown in Table Two is much more on the programmed target of 15% (25:--) than that of the 10.75% for the "D" syllabus. Notably, Flying Deficienies accounted for almost all of the increase. Modern navigator training had come of age: it had designed a program to meet the needs of the Air Force using the advanced tools of technology.

SPECIALIZED UNDERGRADUATE NAVIGATOR TRAINING (SUNT)

The current navigator training program, SUNT, is truly more of an evolution rather than a revolution. SUNT could broadly be described as the "F" syllabus and its follow-on courses more logically and functionally restructured.

> In the past, officers completing undergraduate navigator training could be assigned to any aircraft in the DOD inventory. The training provided them with a broad foundation in basic navigation skills. . . . But feedback from former students and the commands revealed that many of the skills taught at Mather were not always used. Instead, training needed to keep pace with the mission of navigators that was evolving differently in each using command. (7:18)

Beginning with the first class in mid-1986, (5:68) the program now consists of a 65 training-day "Core" course that is mandatory for all students. Then, depending upon their operationally assigned aircraft, students enter the 1) Fighter, Attack, and Reconnaissance (FAR) course; 2) Tanker, Transport, and Bomber (TTB) course; or 3) Electronic Warfare Officer Training (EWOT) course. (5:68) Each of the follow-on courses (FAR, TTB, EWOT) are referred to as "tracks." The type, amount, and emphasis of training varies from track to track. For instance, all three tracks address low level flight, however, the FAR track contains T-37 as well as T-43 low level flights, while the EWOT track flying program is exclusively T-43 low level flights. The TTB track, on the other hand, contains extensive day and night celestial training--the FAR and EWOT track have no celestial training. (12:1; 15:1; 14:2; 13:2) However, a major difference from the "F" syllabus, students are **not** awarded their wings and the aeronautical rating of navigator until graduation from a particular track. (5:71) The newly graduated navigators subsequently attend additional training for their specific operational aircraft at formal schools conducted by gaining commands at other bases.

The similarities between the 1) "F" syllabus and its follow-on-training and, 2) SUNT and its track courses are many. Advanced Navigation preceded TTB, Tactical Navigation preceded FAR, and Electronic Warfare preceded EWOT. (21:11-13) The major shift has been towards a shorter "Core" course and then a longer, more specialized course, awarding wings at the completion of this training. Far from radical, SUNT is an evolutionary step in navigator training. SUNT is designed to provide an improved blend of program and technology to produce a better trained navigator.

Chapter Three

PHYSICAL AND PSYCHOLOGICAL STRESSES OF THE AIRBORNE ENVIRONMENT

In this chapter the author will examine some of the major physical and psychological characteristics of the airborne environment and how the crewmember acts and reacts to them. It is pivotal to understand the dynamics of these characteristics to better comprehend the stresses of the environment in which a crewmember must learn to function. While such things like noise, vibration and fatigue may occur in other environments besides flying, it is their interlocking relationship with such things as airsickness and Manifestation of Apprehension (MOA) that link the former with the airborne environment. Finally, the intensity, uncontrollability, and the inescapability of these stresses further indentify the unique character of the airborne environment. Consideration must be given to these stress characteristics in the design of any flying training program.

NOISE

The interior of an airborne aircraft is constantly bombarded by a variety of noises and these noises have numerous and varied effects on crewmembers. "Continuous loud noise produces irritability and a sense of fatigue. . . . The central nervous system is also presumed to mediate chronic stress effects attributed to noise. . . ." (1:155) However noise, mixed with other demands, may have varied results on crewmembers. ". . . the effects of noise on performance in the presence of other stressful agents or other psychological infuences [are] complex, and cannot simply be [summarized] as adverse in all circumstances." (1:168) As a result, noise may adversely effect crewmember performance and actions, but there may be markedly different reactions to noise between individual crewmembers. Close companions to aircraft noise are vibration and turbulence.

VIBRATION AND TURBULENCE

Vibration and turbulence also impact upon a crewmember's performance. "Flight experience, as well as some experiments, indicate that vibration can also degrade performance centrally, acting in a nonspecific way as a stressful, distracting and fatiguing agent, much as does noise. . . ." (1:51) ". . . when flying in rough air or exposed to intense low-frequency mechanical vibration from other sources, the ease of the pilot's task, or the speed and accuracy with which a navigator can work, are threatened and sometimes seriously impaired." (1:51) "In severe turbulence, observers and navigators find that they are forced to work more slowly because of interruption of their work by jolting (particularly when using hand-held aids.) The result is they are able to complete fewer observations or computations in a given time. . . ." (1:53) "Non-pilots. . . are at greater risk of succumbing to airsickness during flight in heavy turbulence, which may further reduce their performance or incapacitate them." (1:53) Vibration and turbulence, similiar to noise, tend to degrade the crewmember's ability to perform in the airborne environment and the crewmember's reaction to these stresses may even result in airsickness (discussed below).

FATIGUE

Fatigue is the combined result of (reaction to) noise, vibration and turbulence as well as other factors inherent to the airborne environment.

> [Flying] has a large element of boredom arising from monotony. The sensory apparatus becomes fatigued by hours of ranging the eyes over the instrument panel and by listening to radio over the continuous power hum. To this must be added the emotional strain of the necessity for constant alertness. Fatigue centers in the nervous system. Bombardiers [and navigators]. . . are subject to similar acute fatigue. (8:41)

The effect of and reaction to fatigue by an individual crewmember is of particular importance here. "Fatigue is a progressive decline on a [crewmember's] ability to perform his appointed task. It may make its presence known by the deterioration of the quality of his performance, or his inability to keep up with the rate of work required of him." (8:40) As a consequence, aircrew fatigue results from the effects of numerous internal and external factors working in concert which relentlessly wear down the crewmember's ability to effectively perform in the airborne environment.

AIRSICKNESS

Airsickness results from a varied number of physical and psychological factors associated with the airborne environment.

> People who have sensitive organs of balance are more likely to become upset by the pitch and rolling motions, such as those encountered during flight. Among contributing factors to airsickness are noxious odors (such as the odor of gasoline), cold, noise, vibrations,

lack of visual orientation and undue sensitiveness of the nervous system because of the psychologic factors such as the fear of flight. (8:39)

Air Training Command Regulation (ATCR) 51-2 further relates the types and effects of airsickness to the flying training environment.

> Airsickness. . . is defined as active or passive. Active airsickness includes vomiting. Passive airsickness does not include vomiting, but does result in significant deviation in the mission profile due to the student's discomfort or nausea. Most airsickness is of brief duration and is related to multiaxial accelerations, pulling Gs, unfamiliar aircraft attitudes and anxiety. (11:2)

As a result, airsickness can be brought on by any combination of factors and can be a stress, a reaction, or both, depending upon a particular set of airborne circumstances.

MANIFESTATION OF APPREHENSION (MOA)

MOA is the correct terminology for what is more commonly referred to as "fear of flying." As noted in Table Two, Chapter Two, MOAs only accounted for 44 student attritions over a ten-year period. However, it is far less costly in manpower and training time to identify and eliminate cases of MOA early in training. MOA is defined as:

> A state of psychological anxiety, apprehension, and (or) physical impairment exhibited by [SUNT] students toward their training environment. . . . Although some slight anxiety or nervousness is common among students learning to fly, real fear of flying or fear of failure can interfere with a student's judgement, decision-making ability, and physical ability to control and (or) function in the aircraft. MOA indicators may include such symptoms as passive and active airsickness, insomnia, loss of appetite, anxiety, and tension related to the flying environment. (11:1)

Although relatively uncommon, it is quite apparent that fear of flying, or MOA, can have a severe impact on a crewmember's ability to effectively function in the airborne environment. It is important to note that MOA contains several elements or derivatives of previously mentioned stresses and their reactions, further illustrating the interconnecting relationship between them and the airborne environment.

The foregoing list of physical and psychological stresses of the airborne environment and their reactions are not meant to be all-inclusive. Rather, they encompass the major stresses which normally occur regularly or continuously in flight and are generally considered outside the crewmember's immediate control. For instance, cabin temperature and altitude can be quickly controlled on modern aircraft, so their physical effects are transitory in nature. Similarly, emergencies, such as a rapid decompression, may have dramatic physical effects, however, they too are transitory and do not impact upon the crewmember's routine performance. Further, emotional stress from such things as divorce, personality clashes, and financial difficulty are localized to the individual crewmember(s), exterior to the airborne environment, and at least partially within the crewmember's control. Lastly, combat stress, while it can have powerful impact on crewmembers, is clearly outside the confines of the training environment and will not be discussed here. Rather, the author focused the list on those routine physical and psychological factors of the airborne environment and their relationship to **stress** on the crewmember.

The discussions of the above stress factors and their reactions demonstrate how each may impact upon an individual crewmember's performance in a variety of ways. While previous discussions may infer that the effects of stress are always adverse, it is important to point out that such may not always be the case. Whether stress' impact is beneficial or detrimental is largely governed by the degree of stress and the particular crewmember's reaction. "Moderate levels of stress appear to accompany the most effective learning. . . ." (10:5) ". . . stress plays an important role in human sensing, perception and learning. . . ." (10:5) However, each of these physical and psychological factors, singularly or in combination, have demonstrated the potential to create high degrees of stress, depending upon a particular crewmember's reaction to them. The importance, from a training standpoint, is that stress is an integral and possibly beneficial part of flying training, but an individual's ability to deal with the stresses of the airborne environment may well determine his or her suitability as a crewmember.

Chapter Four

SIMULATORS AND FLIGHT TRAINING

Simulators are often viewed as a panacea for a multitude of training and operational problems. Simulators certainly cut down on fuel consumption. They are well suited for practicing dangerous maneuvers that might prove disastrous in an actual aircraft. Many simulators are designed to accomplish a mission or task without having to employ a full crew complement. Weather and time-of-day conditions can be changed at will. "Pre-canned" mission profiles cut down on preflight preparation and are not readily subject to change or cancellation from external forces such as weather, traffic, and maintenance. It certainly appears then that simulators are the vangard of future flight training. Technology has advanced capabilities immensely, providing the Air Force with high fidelity simulators incorporating motion and visual systems. However, the following quotation concerning simulator advancements helps to give the reader a perspective on the past and a direction for the future:

> If one looks back on the progress in simulation during the past three decades, there is little that is radically new, with the exception of digital computer technology, which permitted the realization and exploitation of earlier ideas. It might be noted that many systems such as aircraft. . . and weapon systems that are entering the inventory and being simulated today may be in use 20 to 25 years from now. (3:84)

The trend within research and development as well as operational and training communities has been toward more productive use of simulator technology and systems. "[The] evolution of simulation has been primarily a matter of technological advancements to make simulators more realistic, accurate, and comprehensive representations of a particular item of equipment or system." (3:27) However:

> At this stage of advanced simulator technology, human behavior, rather than equipment, has become the central concern in simulation. Improvements in the design and use of simulators are more likely to depend on development and use of behavioral knowledge than on advances in

engineering technology. In terms of behavior, the primary goals of simulation are facilitating the learning that transfers to the operational context in the case of training simulators. . . . (3:26)

"Because the history of simulator development is characterized by striving for improved realism through the advancement of technology, it is easy to forget that the learning or performance - not physical duplication - is the primary goal." (3:28)

In view of the current trends in simulator advancements, the author found it more practical and realistic to confine the definition of "state-of-the-art" to those research and development programs the Air Force currently has under study. Limiting the scope helped focus research on those programs and systems which might reasonably be found on current and future Air Force simulators. The major Air Force simulator research and development programs presently include the following: a supportable computer language (Ada), modularity of components, part-task trainers, simulator maintainability, and visual systems. (36:--) The concept behind these programs is designed to put more emphasis on how to improve upon or make better use of state-of-the-art simulator technology.(36:--) Lieutenant General Chavernie's testimony on the Limits of Simulation before the Senate Armed Services Committee hearings on the Development and Use of Training Simulators puts the rationale for this concept in perspective: "Attempting to achieve perfect replication may drive simulator costs through the roof without producing a commensurate training payoff." (24:7) In what could be characterized as a more enlightened approach, ". . . physical realism is not the only or optimal means for achieving the behavioral objectives of simulation." (3:28) As a result, state-of-the-art in simulation programs and research has shifted from **technologically superior simulators to superior use of simulator technology.**

There has also been a concurrent shift in policy concerning the use of simulators as well. Major General Harold J.M. Williams, Director of Operational Requirements, Deputy Chief of Staff for Research, Development, and Acquisition, explains the shift:

> . . . we took a close look at our policy for managing the simulator business and made some changes to it. . .
> . . . .
> The Air Force aims to use simulation wherever possible to provide the best and most cost effective training from the entry level right on up to the fully combat capable level, or even beyond. We tend to focus our efforts on two general tasks, the first one being simply the basic task of teaching an aircrew how to operate a specific aircraft or a system and how to fly it safely, with particular emphasis on the safety, and then the

second one, the refining or the honing of the war-fighting skills that the aircrew needs to get maximum combat effectiveness out of the aircraft or the system. (24:47)

The same shift in emphasis can be seen in Air Force Simulator Policy as well: "Concentrate simulator training on tasks that cannot be effectively trained in the aircraft." (24:47) As discussed earlier, that policy shift has spilled over into the research and development arena as well. Ada is a new computer language which is more "user-friendly" towards simulator design and modification. It is both extremely supportable and maintainable. (36:--) "The advent of the Department of Defense's standard software language -Ada- should yield payoffs for simulation. The babel of software languages currently driving simulators will disappear with the implementation of Ada as the DOD standard, thereby reducing software maintenance costs." (4:55) Modularity of components provides for the interchangeability of common hardware between simulator systems. (36:--) In regards to the development of part-task simulators:

> For some purposes it is not cost-effective to use complex devices for training a limited set of tasks or simple tasks, such as procedures; the full range of capabilities of a simulator may not be necessary. When a large number of people need to be trained, multiple large simulators may not be affordable. For these reasons, less expensive part-task simulators have been developed. (3:18)

Maintainability, on the other hand, is an across-the-board look at designing more reliable simulator systems, which is part of the rationale behind a new language and modularity of components. (36:--) Visual systems allow the introduction of a broad spectrum of previously unthinkable training and combat scenarios including formation flight, low-level flight, refueling, and battlefield environments. (36:--) In sum, the underlying theme of Air Force simulator research and development as well as policy has not been towards a technologically grandiose piece of hardware, but rather to design and use simulators to train crewmembers 1) in preparation for the aircraft, and 2) in those tasks which cannot be practically or safely conducted in the aircraft.

At this point, it is best to provide a somewhat more refined concept of what constitutes an aircraft simulator, in particular as it pertains to this research paper. The term "simulator" is a popular term generally used to refer to a wide range of systems more appropriately referred to as Aircrew Training Devices (ATDs). Both terms will be considered interchangeable for the purposes of this research. In this paper, the author will generally concentrate on the larger, more complex, full-task ATDs which have the capability to closely replicate an aircraft or crew station.

> An Aircrew Training Device (ATD) serves two functions. First, it is a ground-based substitute aircraft that permits student crews to fly in a safe and carefully controlled environment. More importantly, as ATD is as its name implies, a teaching machine that is designed to facilitate the acquisition of flight crew skills. (9:11)

"An. . . ATD is not merely a flight simulator. It is also equipped with sophisticated hardware and software capabilities, known as Advanced Instructional Features (AIFs) that permit a simulator instructor to control, monitor, and fabricate simulator training missions." (9:11) As the quotation correctly implies, the instructor in his role as an instructor and the software and hardware available to him are key ingredients in an ATD's effectiveness. The net result is a highly sophisticated aircrew teaching system whose productivity value is largely governed by its hardware/software design and the quality of instruction. Hence, Air Force simulator policy and research trends are evident in ATDs in use today: using technology to facilitate the learning of selected aircrew skills.

Chapter Five

MAJCOMS: THE GAINING COMMANDS

As was pointed out in chapter one, the Air Force's ultimate goal in training navigators is to develop crewmembers prepared and trained to function in a combat environment. SUNT and its track programs provide the fundamental training and skills which gaining commands (SAC, TAC, MAC) build upon to develop navigator crewmembers trained in the combat mission of their specific aircraft. Any radical departure from the current SUNT program however, such as an all-simulator SUNT TTB program, would unquestionably impact upon command training programs as well. Consequently, the inputs of gaining commands are essential toward providing a well-rounded examination of the feasibility of an all-simulator SUNT TTB program.

In this chapter the author will discuss the issues, concerns, and perspectives of nine "field experts" from the gaining commands who train and employ SUNT TTB graduates. Their inputs represent a broad spectrum of experience and weapon systems--both pilots and navigators--who are working in their respective major air command (MAJCOM) headquarters training divisions. They represent the "practical application" arena of the flying training business. They have first-hand experience training in and working with operational aircraft, simulators, and navigators. Much like the test pilot, these field experts help answer whether all the theory, black boxes, and airframes actually do their training jobs. Their responses also help put definition to the art versus the science of navigation and flying and add yet another dimension to the difficult process of quantifying and qualifying the human portion of the flying equation. Finally, their collective experience base balances out the study of the feasibility of converting the SUNT TTB program to an all-simulator course.

The following information provides a collation of the questions posed and their responses. With the exception of Question 6, all answers were spontaneous, with responses being hand or typewritten. Many of the responses were similar, repetitive, or overlapping in nature. For clarity and simplicity, the author synthesized these responses into a single response.

QUESTION 1

What current flying training problems is your command experiencing with junior navigators?

1) Functioning as a crewmember in a multiplaced aircraft. (29:2)
2) Basic airmanship--relying too much on systems. (32:2)
3) Lack of air sense. (31:2)
4) Airsickness/Motion sickness. (28:2)

QUESTION 2

What issues would your formal school have to address in upgrading rated navigators with no flying experience?

1) Addition of simulator and flying training time. (35:3)
2) Higher attrition rates. (35:3)
3) Performance degradation due to lack of flying experience. (30:3)
4) Lack of crew coordination skills and air sense. (26:3)

QUESTION 3

Does your command view flight training as an essential part of the SUNT program? Why or why not? (Note: all respondents considered flight training essential.)

1) It develops an ability to adapt to the stresses and fluid nature of the flying environment. (29:4)
2) The aircraft provides the high-threat, unforgiving, non-stop pressures that are part of the real world flying environment. (30:4)
3) It "weeds out" (ie: attrition) those unable to adapt and function in the airborne environment. (35:4)

QUESTION 4

What is your command's view on what role simulators can or should play in the SUNT TTB program?

1) Simulators should be part of the building block approach, reinforcing classroom know-

ledge and preparing students for the aircraft. (28:5)

2) Simulators provide a controlled environment to teach procedures not feasible or safe in the aircraft. (29:5; 27:5)
3) Simulators are most effective at teaching procedures and pacing. (34:5)
4) Simulators supplement, support, and enhance, but do not replace, flight training. (26:5)
5) Simulators are excellent for practicing weak or deficient procedures. (35:5)

QUESTION 5

How would you define air sense?

1) "A learned sense of 'know-how'. . . that allows he/she to make decisions while in flight. . . . Mission oriented judgement/experience that allows an individual to know where [he/she is], how to react, and what needs to be done next to affect a mission." (32:6)
2) Situational awareness. (34:6; 33:6)
3) "Ability to make snap decisions in flight under adverse/unusual circumstances. To make these decisions an individual must have a wealth of knowledge and experience." (35:6)

QUESTION 6

Overall, how would you rate the concept of training navigators in an all-simulator course? (Respondents were given a choice of A through E)

A) An idea on the leading edge of technology.
B) The current program has the right simulator/flying mix.
C) The current program needs more, not less, flying hours.
D) Simulators can never completely replace actual flying.
E) No way. Simulator trained navigators will not be prepared for increasingly complex operational flying missions.

NOTE: Seven respondents chose D, one chose C and one chose E.

The respondents were not intended to be a scientific cross section or sampling. Rather, they were selected to provide the reader an "operator's perspective" drawn from a highly specialized and trained experience base. As a result, the responses are likely to be subject to an imbedded bias against an expanded use of simulators in flying training.

> . . . skepticism about the usefulness of flight simulation still exists. Though the military recognizes that simulators are a necessary part of its training programs - particularly as it seeks to train more people on increasingly complex equipment - officers are also aware that in some situations simulators cannot replace actual flight experience. Some officers feel that it simply does not require 'the right stuff . . . . (6:38)

The proclivity of negative answers tends to confirm the assertion of an imbedded bias. Viewed the against backdrop of scientific data and professional research though, the respondents' opinions and comments are largely corroborated. For instance, statistics bear out that the largest attrition factor in UNT has historically been flying deficiencies. Further, there appears to be a consensus of opinion and policy that simulators have a major role in flying training, but with distinct limits. Consequently, the responses of these field experts add yet another perspective in the study of the simulator's role in navigator training.

The most prevalent theme running throughout most of the responses was concern about **human adaption to the airborne environment.** It was also noted that there was relatively minor concern over the navigator's proficiency in navigational procedures. The respondents were much more concerned about the navigator's ability to **perform** those navigational procedures under the stresses and unknowns of the airborne environment. Again, the historically large percentage of attritions in UNT, coupled with the performance degradations cited earlier due to the physical and psychological stresses of flight, tend to bear out these concerns. In a different vein, the respondents expressed a high degree of confidence in using simulators to teach procedures and equipment, as a stepping stone to the aircraft. However, they lacked confidence in even a state-of-the-art simulator's ability to acclimate a crewmember to the total flight regime. (32:3) In sum, what the majority of respondents saw as a major stumbling block in converting the SUNT TTB track to an all-simulator program was that simulator capabilities have not reached the point that they can fully re-create the **human experience in the airborne environment.**

Chapter Six

CONCLUSIONS

The training of navigators is a complex and dynamic process. The undergraduate navigator training program of today, SUNT, evolved as programs and syllabi adjusted to meet changes in weapon system, equipment, and AF/MAJCOM needs. Even the shift to "specialization" resulted because "Some ninety-five percent of those trained in a given weapon system were staying in that system throughout their active flying careers." (5:70) Hence, SUNT is a reflection of that AF policy. The key is that SUNT programs are evolutionary, designed to provide the fundamental knowledge, skills and experience which MAJCOMs build upon in molding combat navigators. Could an all-simulator SUNT TTB program then possibly be the next evolutionary step in undergraduate navigator training?

There are three issues to examine in regards to the feasibility of an all-simulator SUNT TTB program. First, is flight training an essential part of training? Second, is it within the potential and purpose of simulators to instill in those student navigators the same experiences they would have gained from flight training? Third, and most importantly, would an all-simulator program graduate be prepared to enter combat crew training? Discussion of these issues will form a basis upon which the author will draw conclusions on the feasibility of an all-simulator SUNT TTB program.

THE IMPORTANCE OF FLIGHT TRAINING

The issue as to whether the experience gained from actual flight is essential to training SUNT TTB navigators lies at the core of the feasibility question. If simulator training replaces flight training, then the voids left actually define the tasks simulators would have to fill. Hence, the issue over the importance of flight training is a fundamental one.

Attrition. A re-examination of attrition provides a quantitative answer about whether flight training is essential. "The school [SUNT] wants to identify those who can't or won't make the grade as early in training as possible. . . . By challenging the students early in training, we eliminate substandard performers

. . . ." (2:19) As table two shows, over a ten year period, encompassing two syllabi, 48.8 percent (710 of 1455) of all attritions were for flying deficiencies. Attrition statistics provide a vivid track record of how important it is for student navigators to adapt to and perform in the airborne environment.

<u>Stress Factors.</u> Stress is inherent in the airborne environment. Direct experience with stress plays an essential role in what is learned during flight training.

> In airplanes. . . the pilot or [navigator] may feel fear or arousal because of what is actually occuring. Those same emotions may not be produced in a simulator because there is no physical risk. The. . . stress associated with operational performance affects what is learned and the strength of the skills that develop, particularly those involving complex decision-making tasks. That is, it is assumed that learning is situationally specific, and operational performance will be inadequate unless the learning situation includes exposure to real stress. (3:62)

As chapter three and the above quotation illustrate, stress can facilitate learning. In regards to flight training, experiencing the stress associated with the physical risk of flying plays an important, if not essential, role in flight training. Stress, *however, may play a negative role* in flight training as well.

Some students have great difficulties adapting to and functioning under the physical and psychological stresses of flying. Noise, vibration, turbulence, and fatigue, in concert with the inherent physical risk of flying may produce adverse effects including performance degradation, airsickness, and MOA. ". . . the [student] with a low threshold for experiencing anxiety. . . may never conquer the over-arousal he experiences in the air. Aircrew selection is designed to select out and reject this type of [student] from flying training." (2:83-3) Consequently, both the beneficial and adverse effects of students experiencing stress in the airborne environment add convincing weight to the essentiality of flight training in the SUNT TTB program.

<u>SIMULATORS -- POTENTIAL AND PURPOSE</u>

The Air Force has taken a major turn away from building and using flight simulators as replacement aircraft, as its primary goal. That is not to say sophistication in flight simulators has peaked out. Sophistication has been targeted toward enhancing training, i.e., preparing students to enter flight training and practicing scenarios impractical or dangerous in real aircraft. Additionally, the role of the instructor and the sophistication surrounding his role have steadily increased. All of this developed as the Air Force realized that state-of-the-art sophistication did not necessarily equate to training effectiveness. In "Human Factors of Simulation" the authors' conclusions highlight the same issues above: overemphasis on physical correspondence, improper use of simulators, and the neglect of human factors in simulation. (3:3) Recognizing these shortfalls, the Air Force has begun to gear its simulator development and training programs toward producing better trained students.

It is actually the human being that limits expanding the simulator's role in flight training. Discussed earlier in this chapter, simulators present no physical risk and that lack affects how the student reacts and what he/she learns. The problem here is one of realism and achieving that realism is difficult. "'In designing most flight simulators,' said Ronald N. Hendricks, vice president and director of Singer-Link, 'the difficulty is not simulating the machine, but the environment.'" (6:39) "Simulating the outside environment and events that affect or drive the simulation can be difficult and expensive, and small gains in realism can be achieved only at great incremental costs." (3:27) Lacking realism, retention becomes a problem for students. "If you train it all in the simulator the first time around, you'll probably forget it by the time you go out and try it in the airplane." (4:59) The Undergraduate Pilot Training (UPT) experience with substituting simulator for flight time best illustrates the limitations human beings place on simulator use.

> Faced with higher fuel prices and fearing embargoes, the service cut back on UPT flying by twenty-one percent. 'We went too far. . . . Over the years we've built back up. It didn't take a rocket scientist to figure out that when [pilot trainees] started busting check rides the first time out, we'd cut too far and relied too heavily on simulation.' (4:56)

The following gives an ATC Headquarters staff perspective on the same issue.

> According to the then [ATC] assistant deputy chief of staff for operations, Colonel Johnny Fender. . . , 'simulators gave students practice in manual skills, but could not teach them to handle the stress of being in a real aircraft. Simulator hours,' he concluded 'cannot directly replace aircraft hours.' (6:39)

The lesson learned is that, in human terms, simulator realism has been insufficient to negate or diminish the need for flight training.

Simulators have become an integral and important part of flight training programs. Whether the T45 is updated with sophisticated modifications or replaced with a state-of-the-art simulator though, neither could feasibly replace the need for flight training in the SUNT TTB program. Flight training has been the only proven medium for imposing the complexity, uncertainty, stress, and potential lethality of the airborne environment upon students. It is, after all, the essence of the SUNT TTB program to train navigators capable of functioning under these conditions. As a result, it is currently not within the purpose or potential of simulators to supplant flight training in the SUNT TTB program.

PREPARATION FOR COMBAT CREW TRAINING

The MAJCOM "field experts" comments tend to echo the conclusions discussed earlier in this chapter: simulators have distinct limits on their capabilities, and flight training is essential for human adaption to the airborne environment. The majority of SUNT TTB graduates are assigned to operational aircraft with large crew complements such as the KC-135, B-52, and C-130. Many MAJCOM training programs and systems are designed to train these crewmembers together as crews. Weapon System Trainer simulators are a good example. The MAJCOMs have valid concerns about the impact an undertrained navigator could have on the length of training required for that navigator and the detriment he could have on the training of the crew as a whole. It is not unreasonable, then, for MAJCOMs to expect navigators to have the knowledge, skills, and experience which prepare them to enter combat crew training. That is the basic function of the SUNT TTB program. With the simulator limitations discussed earlier, the inclusion of flight training in the SUNT TTB program becomes the only feasible way to prepare navigators for combat crew training.

SUMMARY

In the age of technology explosion, it is easy to overestimate the capabilities of that technology. The UPT experience is an excellent example of overestimation of simulator technology capabilities. Simulators play major roles in preparing navigators for flight training and sophistication promises to enhance those roles. However, flight training, particularly initial flight training, has consistently been the bottomline determinant in the decision whether student navigators can successfully adapt to the demands and stress of flying. As a result, the concept of converting the SUNT TTB program to an all-simulator course is simply not feasible.

BIBLIOGRAPHY

A. REFERENCES CITED

Books

1. Guignard, J.C., and P.K. King (eds). _Aeromedical Aspects of Vibration Noise._ Advisory Group for Aerospace Research and Development, AGARD AG-151, London, 1972.

2. O'Conner, P.J., Air Vice Marshall. _Clinical Psychology and Psychiatry of the Aerospace Operational Environment._ Advisory Group for Aerospace Research and Development, AGARD CP-133, London, 1973.

3. Working Group on Simulation. _Human Factors Aspects of Simulation._ Washington DC: National Academy Press, 1985.

Articles and Periodicals

4. Bond, David F. "The Possibilities and Pitfalls of Simulation." _Air Force Magazine_, Vol. 70, No. 12 (December, 1987), pp. 54-59.

5. Callendar, Bruce D. "Navigators With a Difference." _Air Force Magazine_, Vol. 70, No. 12 (December, 1987), pp. 68-76.

6. Fishetti, Mark A. and Carol Truxal (eds). "Simulating the Right Stuff." _The Institute of Electrical and Electronics Engineers Incorporated, Spectrum_, Vol. 22, No. 3 (March, 1985), pp. 38-47.

7. Gillert, Doug. "New Bearings." _Airman_, Vol. 31, No. 2 (February, 1987), pp. 17-21.

Official Documents

8. Aeromedical Research Laboratory. _Physiology of Flight._ Wright Field, Dayton, OH: Motschall Company, 1943.

CONTINUED

9. Air Force Systems Command. Aircrew Training Devices: Utility and Utilization of Advanced Instructional Features. Technical Report No. 85-49. Brooks AFB, TX: Air Force Human Resoures Laboratory, April, 1986.

10. Air Force Systems Command. Stress and Simulation in Pilot Training. Technical Report No. 78-95. Brooks AFB, TX: Air Force Human Resources Laboratory, February, 1979.

11. Air Training Command. Joint Medical and Operations Management Requirements. ATC Regulation 51-2. Randolph AFB, TX, 30 December 1986.

12. Air Training Command. Syllabus of Instruction for Specialized Undergraduate Navigator Training Core Course. S-V8N-C. Randolph AFB, TX, July, 1987.

13. Air Training Command. Syllabus of Instruction for Specialized Undergraduate Navigator Training-Electronic Warfare Officer Training. N-V6A-C. Randolph AFB, TX, July, 1987.

14. Air Training Command. Syllabus of Instruction for Specialized Undergraduate Navigator Training-Fighter, Attack, and Reconnaissance. S-V6A-A. Randolph AFB, TX, October, 1987.

15. Air Training Command. Syllabus of Instruction for Specialized Undergraduate Navigator Training-Tanker, Transport, and Bomber. N-V6A-B. Randolph AFB, TX, September, 1987.

16. Air Training Command. Syllabus of Instruction for Undergraduate Navigator Training. N-V6A-D. Randolph AFB, TX, February, 1977.

17. Air Training Command. Syllabus of Instruction for Undergraduate Navigator Training. N-V6A-F. Randolph AFB, TX, October, 1978.

18. US Department of the Air Force. History of the 323rd Flying Training Wing, 1 January-30 June 1976. Vol. 1. Mather AFB, CA, 1976. FOR OFFICIAL USE ONLY.

CONTINUED

19. US Department of the Air Force. History of the 323rd Flying Training Wing, 1 July-31 December 1974. Vol. 1. Mather AFB, CA, 1975. FOR OFFICIAL USE ONLY.

20. US Department of the Air Force. History of the 323rd Flying Training Wing, 1 July-31 December 1977. Vol. 1. Mather AFB, CA, 1978. FOR OFFICIAL USE ONLY.

21. US Department of the Air Force. History of the 323rd Flying Training Wing, 1 July-31 December 1979. Vol. 1. Mather AFB, CA, 1980. FOR OFFICIAL USE ONLY.

22. US Department of the Air Force. History of the 323rd Flying Training Wing, 1 January-30 June 1985. Vol. 1. Mather AFB, CA, 1985. FOR OFFICIAL USE ONLY.

23. US Department of the Air Force. Officer Classification. AF Regulation 36-1. Washington DC: Government Printing Office, 15 September 1984.

24. US Senate Committee on Armed Services: Subcommittee on Tactical Warfare. Development and Use of Training Simulators. Senate Hearing 98-1205. Washington DC: Government Printing Office, 1985.

Unpublished Materials

25. Air Training Command: "Undergraduate Navigator Training Attrition by Source/by Cause." Unpublished Data Tables for Fiscal Years 1977-1986. Randolph AFB, TX, 1986.

26. Barnard, Benjamin H. Major, USAF. Headquarters, Strategic Air Command, Training Division, Offutt AFB, NE, Letter to Major Sauerbry, 27 October 1987.

27. Boschert, Kermit V., Major, USAF. Headquarters, Strategic Air Command, Training Division, Offutt AFB, NE, Letter to Major Sauerbry, 27 October 1987.

28. Butler, L.W., Major, USAF. Headquarters, Strategic Air Command, Training Division, Offutt AFB, NE, Letter to Major Sauerbry, 27 October 1987.

CONTINUED

29. Crabtree, Eric W., Major, USAF. Headquarters, Tactical Air Command, Training Division, Langley AFB, VA, Letter to Major Sauerbry, 27 October 1987.

30. Crook, Jimmy C., Major, USAF. Headquarters, Strategic Air Command, Training Division, Offutt AFB, NE, Letter to Major Sauerbry, 27 October 1987.

31. Fingerlin, Richard, Major, USAF. Headquarters, Strategic Air Command, Training Division, Offutt AFB, NE, Letter to Major Sauerbry, 27 October 1987.

32. Johnson, Leon, Major, USAF. Headquarters, Strategic Air Command, Training Division, Offutt AFB, NE, Letter to Major Sauerbry, 27 October 1987.

33. Pettiet, Thomas G., Major, USAF. Headquarters, Strategic Air Command, Training Division, Offutt AFB, NE, Letter to Major Sauerbry, 27 October 1987.

34. US Department of the Air Force: Directorate of Programs and Evaluation. "Think Piece on Replacing T-43 Aircraft in Undergraduate Navigator Training with State-of-the-Art Simulators." Talking Paper. Washington DC, 10 April 1987.

35. Van Splunden, Tim, Captain, USAF. Headquarters, Strategic Air Command, Training Division, Offutt AFB, NE, Letter to Major Sauerbry, 27 October 1987.

<u>Other Sources</u>

36. Lloyd, William, Air Force Deputy for Simulators, Wright-Patterson AFB, Ohio, Telecon, 18 November 1987.

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